MARKETING RESEARCH REPORT No. 917

The EGG PRODUCTS INDUSTRY:

Structure, Practices, and Costs 1951-69

U.S. DEPARTMENT OF AGRICULTURE

ABSTRACT

Though historically the West North Central region accounted for over 70 percent of U.S. liquid-egg production, the share is now half or less; such production has increased in the South and West. Further shifts in regional importance are expected in the 1970's. Per capita consumption of egg products has gone up since 1951, while shell egg consumption has decreased, causing a 20-percent decline in total per capita egg consumption during 1951-69. Egg breaking remains highly seasonal though not as much as it was in the early 1950's. The percentage of liquid eggs for immediate consumption has increased slightly in the past two decades. Output of frozen liquid eggs fell from being two-thirds to about half of total output, but the share of liquid eggs being dried went from 15 to almost 40 percent. Heat remains the pasteurization method for liquid eggs, with costs of 0.20 to 0.45 cents a pound; irradiation is not yet economically feasible.

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GLOSSARY

Certain terms are commonplace in the commercial egg-breaking and egg-drying industry. The terms and their definitions, as used in this report, are:

Albumen solids: (1) Pan-dried albumen in flake, granular, or powdered form or (2) spray-dried albumen in powdered form.

Breaking stock: Shell eggs used for breaking.

Dried yield: The quantity of dried product obtained from 100 pounds of liquid whole eggs, yolks, or albumen.

Egg meats: The contents of an egg, including the yolk and the albumen but excluding the shell membrane and the shell.

Egg products: Whole eggs, whole-egg blends, albumen (or whites), and yolks (plain, sugared, and salted) in liquid or frozen forms or both, and in dried form.

Egg solids: A term used synonymously with dried eggs. There are many types but the most common are whole eggs, albumen, whole-egg blends, and yolk solids.

Emulsion: An oily mass in suspension in a watery liquid; for example, salad oil is an emulsion of egg yolks mixed with water, starch, vegetable oils, and spices.

Frozen mixed whole eggs: A term used by the Statistical Reporting Service (SRS), USDA, to mean whole eggs to which extra yolks and sugar, salt, or syrup have been added according to packers' own formulas. In the trade, these products are generally referred to as "whole-egg blends."

Frozen plain 43-percent yolks: Yolks with a minimum of 43-percent solids and no additives.

Frozen plain 45-percent yolks: Yolks with a minimum of 45-percent solids and no additives.

Frozen salted yolks: Yolks with a minimum of 43-percent solids and containing approximately 10-percent salt.

Frozen sugared yolks: Yolks with a minimum of 43-percent solids and containing approximately 10-percent sugar.

Frozen whites (standard): Whites with customer specifications, usually indicating a minimum of 11.5-percent solids, and a fat content not over .03 percent.

Frozen whole eggs: A mixture of whites and yolks in natural proportions as broken, with no additives, and usually containing 25- to 26.5 percent solids.

Liquid yield: The quantity (pounds) of egg products (whole eggs or albumen and yolks) in liquid form obtained from a case of shell eggs.

NEPA color: The color rating of a yolk or whole-egg sample, obtained by use of the method originally developed by the National Egg Products Association Laboratory.

Other yolk: A term used by SRS to mean emulsions consisting of yolk mixed with other ingredients such as glycerin or syrup.

Percentage yield: The proportions that yolk and albumen, respectively, account for of total separated stock.

Solids content: Liquid eggs are composed of water and solids (that is, proteins, fats, vitamins, and minerals). The solids content is what remains after the water has been removed.

Used for immediate consumption: Egg products delivered in liquid, unfrozen form to the user.

Whole-egg solids (or dried whole eggs): Whole eggs in natural proportions dried to a powder by a spray-drier and containing a maximum of 5-percent moisture.

This glossary is based mainly on one prepared by Koudele and Heinsohn (13, pp. 7 and 8). (Underscored numbers in parentheses refer to the references at the end of this report.)

HIGHLIGHTS

Per capita consumption of liquid, frozen, and dried eggs has risen since the early 1950's. But per capita consumption of shell eggs has declined by a greater, offsetting amount. Thus, total per capita consumption of all eggs has dropped--by 20 percent during 1951-69. The share of eggs for breaking in total egg production--6.6 percent in 1951--had reached 10 percent by the late 1960's.

Demand for egg products is generally believed to be more inelastic than demand for shell eggs, although this relationship varies seasonally. The egg-breaking operation remains highly seasonal, though far less so than in the early 1950's; and it may become less seasonal in the 1970's. Breaking volume also varies from year to year, with changes in price levels and yearend storage holdings. Typically done in the low-price late winter and spring periods, egg breaking provides an important outlet for seasonal surpluses and thus substantially supports shell egg prices during these periods. Prices of eggs for breaking are linked to shell egg prices, but breaking use is secondary in importance to use in the table egg market.

During the 1950's and 1960's, the relative importance of liquid, frozen, and dried eggs changed. The percentage of liquid eggs used for immediate consumption increased slightly. Frozen liquid eggs decreased from being about two-thirds of total volume early in the period to about half late in the period. The percentage of liquid eggs being dried rose from 15 to nearly 40 percent.

The recent introduction of consumer and institutional convenience egg products on the market has extended their use beyond the traditionally important uses by bakers, confectioners, premix manufacturers, and food manufacturers.

Historically, the West North Central region accounted for over 70 percent of U.S. liquid-egg production, but its share of total volume has declined, as have its plant numbers. Egg production has expanded in the South and West; and egg breaking is increasing in importance in those regions. Consequently, the West North Central region now accounts for half or less of U.S. liquid-egg production. Further shifts in the relative importance of the regions are likely, and will reflect these recent trends.

The estimated dollar value of liquid-egg production rose from about $130 million to nearly $200 million during 1950-69. The 10 largest firms in the egg products industry accounted for about 45 percent of liquid- and frozen-egg output. For dried eggs, the proportion was almost 90 percent of total output.

Most broken-out eggs remaining in liquid form are distributed locally. Frozen and dried eggs often move much longer distances. Transportation costs for frozen eggs going to Northeastern cities range from 1 to 2 cents a pound, depending on the areas supplying the eggs. Other marketing costs may include brokers' charges, and interest, cold storage, and warehouse costs.

Costs per dozen for procuring shell eggs for breaking are similar to those for eggs intended for the table egg market, and range from less than 1/4 cent to 1 cent a dozen, depending on distances hauled. Eggs used for breaking usually are priced lower than table eggs because of the heavy use of undergrades and smaller sizes. Breaking-plant costs range from 4 to 5 cents per pound of liquid eggs. Costs of drying whole eggs range from 7 to 13 cents a pound.

Heat pasteurization is generally used on liquid eggs, and the costs range from 0.20 to 0.45 cents a pound. Currently, irradiating processed eggs would be several times as expensive, and it is not now considered economically feasible.

THE EGG PRODUCTS INDUSTRY: STRUCTURE, PRACTICES, AND COSTS, 1951-69

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INTRODUCTION

The manufacture of egg products begins with shell eggs of the domestic hen. These eggs are broken out to obtain liquid whole eggs and mixed whole eggs with the yolks and albumen in their natural proportions. Yolks and albumen are separated to produce liquid yolks and albumen. Whole-egg meats (defined in glossary) or mixed whole eggs, yolks, or albumen may be sold in liquid, frozen, or dried form to further processors. Sugar, salt, or glycerin may be added before sale, depending on the use for the product. To free them of viable salmonellae, egg products moving in interstate commerce must be pasteurized (23 and 24). 1/

Egg products are used mainly by bakers, confectioners, premix manufacturers, and food manufacturers of baby food, noodles and macaroni, mayonnaise and salad dressings, ice cream, and a large variety of other food products. Only during World War II and recently have egg products been available in packages of a size for home use.

The years covered in this report are 1951-69. The beginning year was selected because it appeared to be the first postwar year when World War II Government purchase programs did not have a major effect on the egg products industry. 2/ The objectives of the study were to examine (a) production, (b) processing, (c) marketing, and (d) demand; and when possible, to show trends.

PRODUCTION

Total Production

U.S. egg production increased from 58 billion eggs in 1951 to nearly 69 billion in 1969. Prices received by producers varied, but dropped from 48 cents in 1951 and 1953 to a low of 31 cents in 1967. As a result, the value of egg production at the beginning of the period was $2 billion or more, but toward the end reached and passed the $2 billion mark only in 1966 and 1969 (table 1). Figure 1 shows the areas in which egg production is concentrated.

Shifts have occurred in regional egg production during the past 10 years. Production has increased in the South Atlantic, South Central, and Western regions. Moderate declines have taken place in the North Atlantic and East North Central regions, but a large drop has occurred in the West North Central region (table 2).

1/ Underscored numbers in parenthesis refer to the references at the end of the report.

2/ Two reports by Koudele and Heinsohn (12 and 13) give the history of the industry back to 1900.

Table 1.--Eggs: Production, price per dozen received by producers, and value of production, United States, 1951-69

Year	Production	Price received by producers per dozen eggs	Value of production
	Millions	Cents	Million dollars
1951	58,063	48	2,298
1952	58,068	42	2,002
1953	57,891	48	2,289
1954	58,933	37	1,795
1955	59,526	39	1,955
1956	61,113	39	2,003
1957	61,026	36	1,826
1958	61,607	38	1,978
1959	63,335	31	1,656
1960	61,462	36	1,841
1961	62,265	35	1,840
1962	63,404	34	1,779
1963	63,324	34	1,816
1964	65,022	34	1,828
1965	65,493	34	1,836
1966	66,286	39	2,156
1967	69,826	31	1,812
1968	69,058	34	1,952
1969 1/	68,720	40	2,286

1/ Preliminary.

Source: Compiled from unpublished data from Stat. Rptg. Serv., U.S. Dept. Agr.

Table 2.--Eggs: Number produced and production as percentage of total, by region, 5-year averages, 1960-64 and 1965-69

Region	Production		As percentage of total	
	1960-64	1965-69	1960-64	1965-69
	Millions		Percent	
North Atlantic	9,878	9,800	15.7	14.4
East North Central	10,265	9,612	16.3	14.2
West North Central	13,846	10,760	21.9	15.9
South Atlantic	9,407	12,949	14.9	19.1
South Central	10,256	13,816	16.3	20.3
West	9,443	10,939	14.9	16.1
United States	63,095	67,877	100.0	100.0

Source: Computed from unpublished data from Stat. Rptg. Serv., U.S. Dept.Agr.

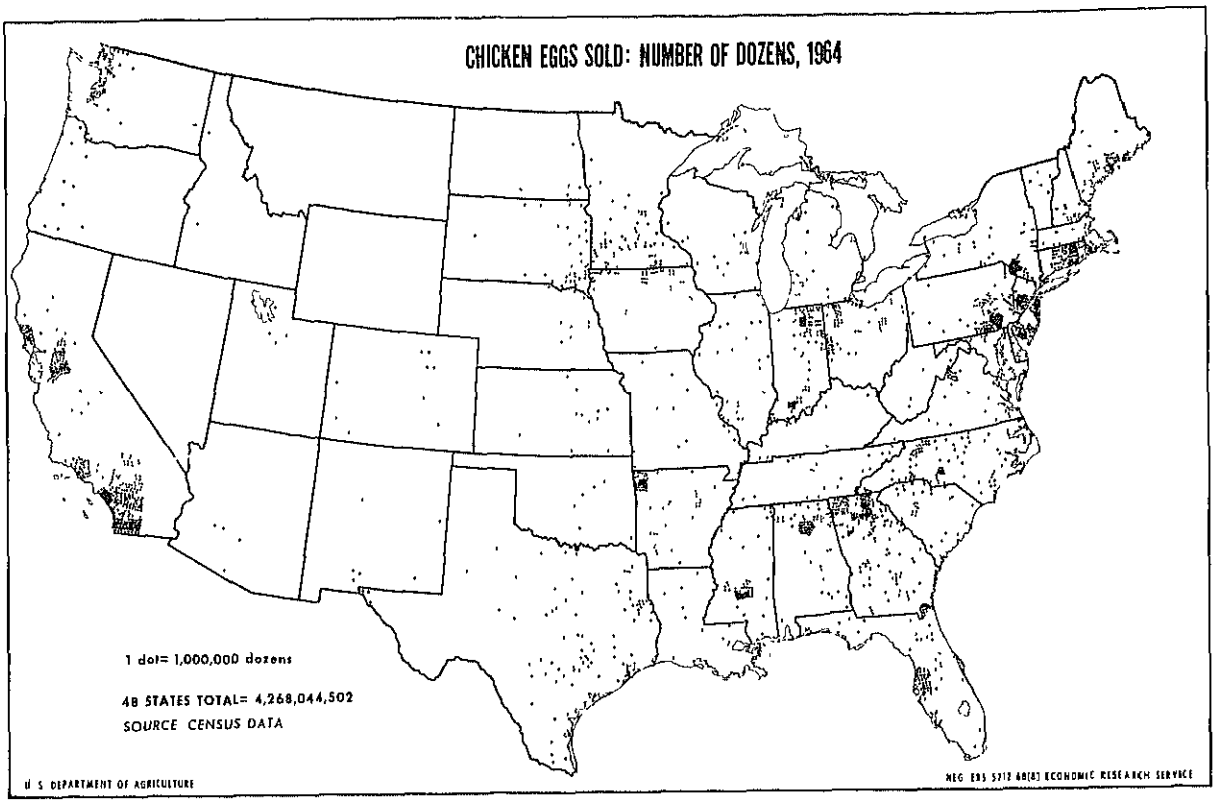

Figure I

Eggs Used for Breaking

During the past 15 years, the number of eggs used for breaking has almost doubled. As a percentage of all eggs produced, this type increased from about 6 percent in the early 1950's to nearly 10 percent in the late 1960's. During the same period, wholesale selling prices of frozen eggs showed a downward trend. However, the estimated value of liquid eggs produced increased from about $130 million early in the period to nearly $200 million by the late 1960's; the increase in production (discussed below) was greater than the decline in price (table 3).

Liquid-Egg Production and Disposition

Production of liquid eggs about doubled from the early 1950's to the late 1960's, reaching a peak of 800 million pounds in 1967. During this period, about 5 percent was used for immediate consumption, about 50 percent was frozen, and the remaining 45 percent was dried to produce egg solids. Trends were: a small increase in the percentage of liquid eggs used for immediate consumption; a decrease in the percentage of liquid eggs being frozen from about two-thirds of total liquid egg production early in the period to about half late in the period; and an increase in the percentage of liquid eggs being dried from about 15 percent early in the period to nearly 40 percent in the later years (table 4).

Liquid-Egg Production by Class of Product

About half the liquid eggs produced are whole eggs and mixed emulsions. Egg whites account for about one-fourth, and the various kinds of yolks, about one-fourth. All classes of egg products showed upward trends during the 17-year

period 1951-67, but the trends were not uniform. The whole egg,with yolks and whites in their natural proportions, was usually the largest class of product during 1951 through 1969. At times, more whites were produced than whole eggs, but in general, egg whites were second to whole eggs in pounds produced. Yolks

Table 3.--Eggs used for breaking: Number, liquid eggs produced, wholesale selling price of frozen eggs, and estimated value of liquid eggs produced, United States, 1951-69

Year	Eggs used for breaking		Liquid eggs produced	Eggs used for breaking as a percentage of total egg production	Wholesale selling price of frozen eggs at New York City 2/	Estimated value of liquid eggs produced
	Mil.	1,000 cases 1/	Mil. lbs.	Pct.	Cents per lb.	1,000 dol.
1951	3,821	10,614	409	6.6	34.8	142,332
1952	3,575	9,927	382	6.2	30.4	116,128
1953	3,846	10,682	411	6.6	37.9	155,769
1954	4,357	12,103	466	7.4	28.4	132,344
1955	4,240	11,778	453	7.1	31.7	143,601
1956	4,346	12,074	465	7.1	30.9	143,685
1957	4,439	12,331	475	7.3	27.5	130,625
1958	4,382	12,172	481	7.1	30.2	145,262
1959	6,389	17,755	701	10.1	26.0	182,260
1960	5,310	14,746	582	8.6	27.9	162,378
1961	5,789	16,074	635	9.3	30.4	193,040
1962	5,784	16,070	635	9.1	27.7	175,895
1963	5,351	14,860	587	8.4	26.8	157,316
1964	6,006	16,684	659	9.2	26.0	171,340
1965	5,730	15,919	629	8.7	25.7	161,653
1966	5,663	15,731	621	8.5	31.8	197,478
1967	7,307	20,297	802	10.5	24.7	198,094
1968	6,168	17,134	677	8.9	23.9	161,803
1969	5,836	16,212	640	8.5	30.5	195,200

1/ A case contains 30 dozen (360) eggs.
2/ Poultry Market Statistics, Consum. and Mktg. Serv., U.S. Dept. Agr.

Source: Compiled from unpublished data from Stat. Rptg. Serv. and Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 4.--Liquid eggs: Production and disposition, United States, 1951-67

Year	Production	Disposition of liquid eggs						
		For immediate consumption	Frozen				Dried	Frozen and later dried
			Whole	Albumen	Yolk	Total		
	Million pounds							
1951	409	18	175	95	69	340	51	23
1952	382	18	149	103	69	320	44	32
1953	411	21	162	104	76	343	47	34
1954	466	31	162	101	89	361	74	28
1955	453	33	152	101	88	342	79	32
1956	465	33	157	109	83	349	83	19
1957	475	37	149	102	82	334	103	24
1958	481	31	155	107	89	351	99	16
1959	701	51	219	117	100	436	214	10
1960	582	44	172	104	86	362	176	8
1961	635	50	184	95	92	371	214	3
1962	635	55	185	104	93	382	198	5
1963	587	58	176	91	96	363	166	7
1964	659	68	188	91	103	382	209	3
1965	629	44	191	80	97	368	216	2/
1966	621	40	188	72	96	356	225	2/
1967	802	59	247	78	109	435	307	2/
1968	677	63	204	67	90	361	253	2/
1969	640	82	191	63	80	334	224	2/

1/ Included in middle columns under "Frozen" heading.
2/ Discontinued.

Source: Stat. Rptg. Serv., U.S. Dept. Agr.

Table 5.--Liquid eggs: Production by class of product, United States, 1951-69

Year	Whole	Mixed emulsion	Egg white	Plain yolk	Sugared yolk	Salted yolk	Yolk emulsion	Total yolk
	Million pounds							
1951	141	75	116	26	25	23	2	76
1952	92	73	133	35	24	24	0	83
1953	114	65	138	38	24	32	0	94
1954	112	67	171	49	26	38	2	115
1955	109	64	167	48	28	34	2	112
1956	121	62	173	45	30	32	2	109
1957	142	51	170	47	27	34	3	111
1958	136	57	174	49	31	33	1	114
1959	283	69	212	56	35	42	3	136
1960	227	63	175	49	30	36	2	117
1961	254	69	184	49	34	42	4	129
1962	234	68	196	52	31	46	5	136
1963	168	98	185	40	31	46	8	135
1964	200	111	211	44	37	49	8	138
1965	175	116	200	50	38	46	1/ 4	138
1966	169	129	185	49	2/	2/	1/ 81	139
1967	240	161	236	68	2/	2/	1/165	233
1968	223	143	179	54	2/	2/	1/ 77	131
1969	194	159	162	50			1/ 75	125

1/ Beginning in 1965, "other yolk" figures are shown. Yolk emulsions no longer available.
2/ Amounts shown in "Yolk emulsions" column.

Source: Stat. Rptg. Serv., U.S. Dept. Agr.

showed a strong upward trend during 1951-67 with a decline in 1968-69. Mixed emulsions trailed the other classes of egg products, but also showed a strong upward trend during 1951-67. In recent years, sugared and salted yolks have been reported with yolk emulsions, and the three products are now called "other yolk." Plain yolk is still carried as a separate item (table 5).

Egg-Solids Production by Class of Product

Egg solids (dried eggs) production showed almost a fourfold increase during 1951-69, reaching a peak in 1967 (table 6). The increases were mainly in dried albumen and dried yolks and in the last few years in the "other" category. While some increases occurred in the production of whole-egg solids, these increases were erratic and mainly due to U.S. Department of Agriculture (USDA) purchase programs. The influence of USDA purchases is examined in more detail in the section on demand.

Seasonality of Liquid-Egg Production

Historically, the egg products industry was characterized by a highly seasonal production pattern. The major pack was put up in the spring months, when prices were low. Eggs broken during the remainder of the year came from edible stock that could not be put into consumer cartons or sold to restaurants, hotels, and institutions. Recently, however, there has been more egg breaking year-round. Also, the availability of breaking stock has leveled out somewhat as the seasonality in shell-egg production has decreased. Even so, for 1965-69, the low point in liquid-egg production occurred in November and December at 73 percent of the annual average

Table 6.--Egg solids: Production, United States, 1951-69 1/

Year	Whole	Albumen	Yolk	Other 2/	Total
	Million pounds				
1951	11	4	3	-	18
1952	3	7	8	-	17
1953	5	6	8	-	20
1954	3	9	10	-	23
1955	3	11	9	-	23
1956	5	9	8	-	22
1957	10	10	9	-	29
1958	8	9	8	-	25
1959	32	11	12	-	55
1960	28	8	10	-	46
1961	32	10	12	-	54
1962	27	10	14	-	51
1963	14	9	13	9	45
1964	20	11	11	11	52
1965	10	14	13	13	50
1966	8	14	13	17	51
1967	13	19	19	19	71
1968	14	13	13	26	65
1969	7	10	12	32	61

1/ Also called dried eggs.
2/ Before 1963, data were not available for "other" production.

Source: Stat. Rptg. Serv., U.S. Dept. Agr.

for the 5-year period, while the peak occurred in June at 148 percent of this annual average (table 7). Compared with those of some other industries, this is still a highly seasonal production pattern.

Regional Distribution of Eggs Used for Liquid-Egg Production

Historically, the West North Central region provided most of the eggs used to produce liquid eggs. The East North Central region was second and the remaining regions contributed very little. Basically, this pattern was caused by the surplus-deficit relationships among the regions. For many years, the West North Central region produced a large surplus of eggs. However, in the last two decades, both total and liquid-egg production increased in the South and West, and declined in the West North Central region.

The percentage of egg production broken to produce liquid eggs changed very little during the past 12 years in the North Atlantic, East North Central, and West North Central regions. However, the percentage increased considerably in the remaining regions (table 8).

Regional Distribution of Liquid-Egg Production

Regional patterns and trends for liquid-egg production closely resemble those for eggs used for breaking. The changing shares among the regions in liquid-egg production is perhaps the most interesting aspect of table 9. During 1958-62, the West North Central region dominated liquid-egg production with 72 percent of the output. In 1968-69, the West North Central region remained the most important region in output, by far, but its share had by then fallen to 50 percent.

PROCESSING

Plant Location

Probably no one knows the number of plants in the egg products industry. Many small plants break eggs to meet local needs and do not get involved in interstate commerce. However, most large plants ship in interstate commerce and produce most of their volume under Federal supervision. As might be expected, plants producing egg products are located in areas of heavy egg production generally; and these areas tend to be surplus-producing (fig. 2).

From 1960 to 1969, the overall number of plants producing frozen eggs under Federal supervision decreased from 105 to 92. This was because of the very large decrease in the Midwest, a decline that was not offset by the increases in all other regions. The largest increase occurred in the South and West (table 10).

From 1960 to 1969, the overall number of plants producing dried eggs under Federal supervision increased from 16 to 26. The Northeast had no drying plants under Federal supervision, but the three other regions did and all showed increases in plant numbers. Numbers increased by two in the West, two in the South, and six in the Midwest. Twenty of these plants both freeze and dry eggs. Thus, the 98 dots in figure 2 are 20 less than the total of 118 frozen- and dried-egg plants in table 10 would indicate.

Table 7.--Liquid eggs: Seasonality of production, by month, United States, 1965-69

Month	Production						Production as percentage of annual average					
	1965	1966	1967	1968	1969	Average	1965	1966	1967	1968	1969	Average
	Million pounds						Percent					
January	47	35	58	51	35	45	89	67	87	91	66	80
February	51	33	60	53	38	47	96	63	90	95	72	84
March	66	48	70	63	43	58	125	92	104	113	81	104
April	59	64	77	69	58	65	111	123	115	123	109	116
May	73	78	90	79	75	79	138	150	134	141	142	141
June	83	83	93	76	80	83	157	160	139	136	151	148
July	65	59	75	69	65	67	123	113	112	123	123	120
August	50	46	71	58	56	56	94	88	106	104	106	100
September	39	41	58	42	47	45	74	79	87	75	89	80
October	33	41	56	44	55	46	62	79	84	79	104	82
November	32	44	50	40	41	41	60	85	75	71	77	73
December	31	51	44	33	47	41	58	98	66	59	89	73
Total	629	621	802	677	640	674						
Average	53	52	67	56	53	56						

Source: Stat. Rptg. Serv., U.S. Dept. Agr.

Table 8.--Eggs used for breaking: Estimated quantities used for liquid eggs and as percentage of total egg production, by region, 1958-62, 1963-67, and 1968-69

Region	Eggs broken to produce liquid eggs		
	1958-62	1963-67	1968-69
	Millions		
North Atlantic	111	150	210
East North Central	885	872	866
West North Central	3,982	3,366	2,990
South Atlantic	166	601	720
South Central	166	601	592
West	221	421	592
United States	5,531	6,011	5,970
	Eggs broken to produce liquid eggs as a percentage of eggs produced		
	Percent		
North Atlantic	1.1	1.5	2.2
East North Central	8.1	8.9	9.1
West North Central	26.0	28.3	30.6
South Atlantic	2.1	5.2	5.2
South Central	1.8	4.8	4.1
West	2.5	4.1	5.2
United States	8.9	9.1	8.7

Source: Based on data from selected studies on deliveries of eggs to breakers by plants reporting to U.S. Dept. Agr. Market News Service for the Commercial Egg Movements Report; unpublished data from Poultry Div., Consum. and Mktg. Serv., U.S. Dept. Agr.; and unpublished data from an Econ. Res. Serv. nationwide survey of egg handlers.

Table 9.--Liquid eggs: Estimated quantities produced and as percentage of total liquid-egg production, by region, 1958-62, 1963-67, and 1968-69

Region	Liquid-egg production		
	1958-62	1963-67	1968-69
	Million pounds		
North Atlantic	12	16	23
East North Central	97	96	95
West North Central	437	370	330
South Atlantic	18	66	79
South Central	18	66	66
West	24	46	66
United States	606	660	659
	As percentage of total liquid-egg production		
	Percent		
North Atlantic	2.0	2.5	3.5
East North Central	16.0	14.5	14.5
West North Central	72.0	56.0	50.0
South Atlantic	3.0	10.0	12.0
South Central	3.0	10.0	10.0
West	4.0	7.0	10.0
United States	100.0	100.0	100.0

Source: Based on data from selected studies on deliveries of eggs to breakers by plants reporting to U.S. Dept. Agr. Market News Service for the Commercial Egg Movements Report; unpublished data from Poultry Div., Consum. and Mktg. Serv., U.S. Dept. Agr.; unpublished data from an Econ. Res. Serv. nationwide survey of egg handlers.

Table 10.--Frozen and dried eggs: Plants producing under USDA inspection and grading programs by region, selected years, 1960-69

Region 1/	Plants producing --							
	Frozen eggs				Dried eggs			
	1960	1965	1967	1969	1960	1965	1967	1969
	Number							
Northeast	2	2	4	7	0	0	0	0
South	7	23	17	24	1	2	3	3
Midwest	92	63	51	51	14	16	19	20
West	4	8	12	10	1	3	2	3
Total	105	96	84	92	16	21	24	26

1/ Northeast includes the North Atlantic region; South, the South Atlantic and South Central regions; Midwest, the East and West North Central regions; and West, the Mountain and Pacific Coast regions.

Source: Compiled from the List of Plants Operating Under USDA Poultry and Egg Inspection and Grading Programs, Agr. Mktg. Serv., U.S. Dept. Agr., AMS-15, Dec. 1960 and Consum. and Mktg. Serv., U.S. Dept. Agr., C&MS-SRA-184, Mar. 1965; and List of Plants Operating Under USDA Poultry and Egg Grading and Egg Products Inspection Programs, Consum. and Mktg. Serv., U.S. Dept. Agr., Apr. 1969.

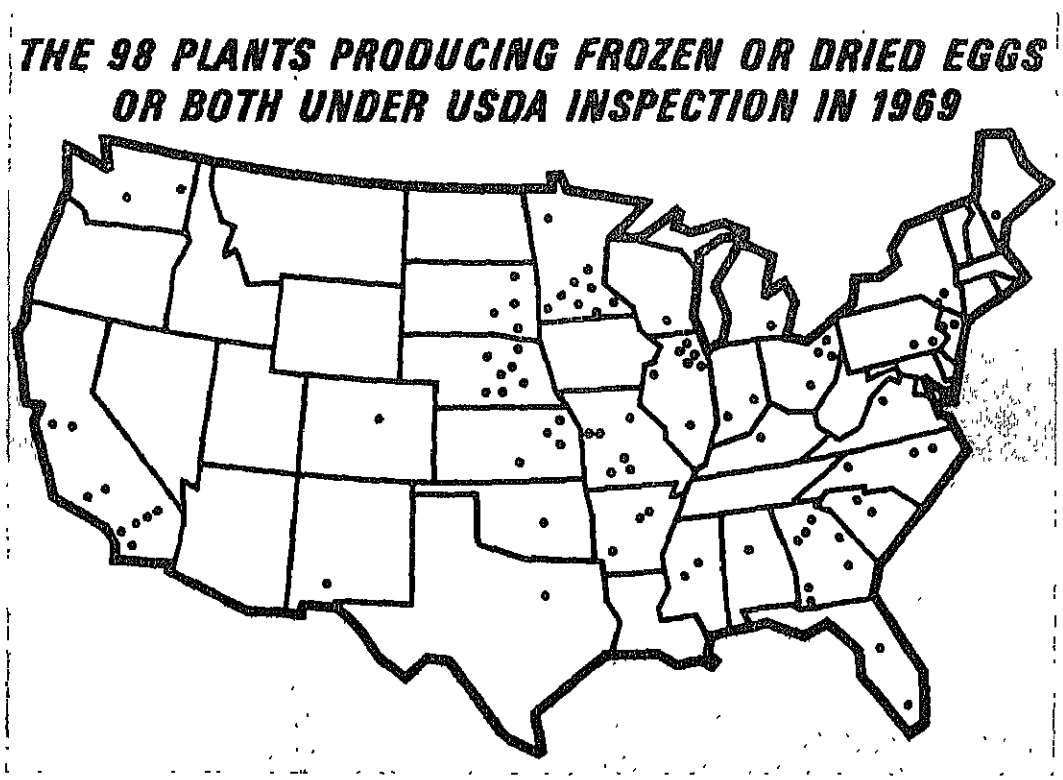

Figure 2

Importance of Plants Operating Under USDA Supervision

In the early 1950's, the plants operating under USDA supervision accounted for about two-thirds of total liquid-egg production. By 1968, the proportion accounted for by these plants was 95 percent (table 11).

Concentration of Plants

A method of measuring changes in the size of firms is to compare the percentages of total volume handled by a specific number of firms in different time periods. A typical procedure is to measure the percentage of output handled by the four and 10 largest firms in an industry (table 12). From 1964 to 1968, little change occurred in the percentage of the product handled by the four and 10 largest liquid- and frozen-, and dried-egg processing firms. There were some changes in the list of firms included from 1964 to 1968 in these two groups, and most of the firms operated more than one plant. The high percentages of output accounted for by the 10 largest egg-drying firms is due in part to the relatively small number of firms in the business.

Plant Operations

Plant operations consist of assembling shell eggs, processing eggs within the plant, and shipping egg products out.

The method of assembling shell eggs varies considerably. In small operations, the eggs for breaking may pass through a hole in a wall as they move from the shell-egg grading and cartoning room into the egg-breaking room. Most egg breakers send their own trucks to independent shell-egg dealers to pick up eggs; this represents their main source of supply. A second source is the egg purchases by processing plants from shell-egg grading plants. This provides an important market outlet for B-quality, C-quality, and checked eggs; these eggs may approximate 10 percent of total production. A third source is for breakers to produce their own eggs or have them produced under contract. The breakers' objective here is two-fold: first, to assure themselves of a source of supply; and, second, to feed for dark yolk color. Noodle and macaroni manufacturers pay premium prices for dark yolks.

Inplant operations typically consist of: receiving shell eggs; chilling; candling to sort out eggs unfit for human consumption; washing and sanitizing shell eggs; breaking the eggs and removing the contents; inspecting the egg meats; mixing; straining; pasteurizing; cooling; packaging; freezing; and storing. Variations occur when whites and yolks are separated, when salt, sugar, or other ingredients are added, when the whites are put through a desugaring process, and when the eggs are dried instead of frozen.

End-product shipments from egg-processing plants can be in liquid, frozen, or dried form. The liquid form can be in individual cans holding 30 pounds, up to tanker truckloads holding 30,000 pounds or more. The frozen form is typically in 30-pound tin or fibre cans. Freezing may be done at a cold-storage warehouse or at the egg-processing plant. Typically, shipments are in truckload lots. The dried-egg form is packed mainly in metal or fibre drums weighing up to 200 pounds. Again, shipments are usually in truckload lots.

Table 11.--Liquid eggs: Volume produced in plants under USDA supervision compared with total liquid-egg production, United States, 1951-69

Year	Liquid-egg production		
	Total	Under USDA supervision 1/	Share under USDA supervision
	Million pounds		Percent
1951	409	285	70
1952	382	242	63
1953	411	273	66
1954	466	326	70
1955	453	350	77
1956	465	341	73
1957	475	347	73
1958	481	355	74
1959	701	529	75
1960	582	467	80
1961	635	543	86
1962	635	489	77
1963	587	503	86
1964	659	559	85
1965	629	565	90
1966	621	598	96
1967	802	661	82
1968	677	645	95
1969	640	2/	2/

1/ Based on fiscal year data beginning in 1963. Fiscal year data were converted to calendar year by linking half of preceding fiscal year with half of current fiscal year. Example: 1963 = 1/2 of 1963 + 1964.

2/ Not available.

Source: Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 12.--Liquid, frozen, and dried eggs: Output produced by the four and 10 largest firms under Federal inspection, United States, 1964 and 1968

Firms	Total output by --	
	Four largest firms	10 largest firms
	Percent	
Liquid- and frozen-egg processing firms in --		
1964	25	46
1968	24	44
Dried-egg processing firms in --		
1964	58	90
1968	57	87

Source: 1964 data were obtained from Organization and Competition in the Poultry and Egg Industries, Technical Study No. 2, National Commission on Food Mktg., June 1966, p. 19. 1968 data were obtained from the Poultry Division, Consum. and Mktg. Serv., U.S. Dept. Agr.

Costs

Although the egg-processor's costs can be viewed in several ways, a functional approach is followed here; that is, assembly, inplant, and distribution and selling costs are examined.

Cost of assembling shell eggs for egg breakers varies depending on such factors as: density of production, quality of eggs produced, length of pickup routes, number of stops per route, number of cases picked up at each stop, cost and efficiency of labor, and other items. The particular "mix" of these variables determines the individual egg breaker's costs.

Ratcliffe (16, p. 21) studied costs of collecting eggs from farms for 18 cooperatives in three regions. He found that labor and truck costs averaged 32 cents per 30-dozen case of eggs in 1957-58. The range in these costs was from a low of 8 cents to a high of 52 cents.

Conlogue (5, p. ii) studied 20 routes for egg pickup from farms in three Midwestern States. Labor and truck costs in 1959-60 averaged 38.7 cents a case. The lowest cost was 20 cents and the highest was 59.4 cents.

In a 1959 study, Jones and Thompson (10, p. 9) noted that "assembly costs vary from 1/2 to 1 cent per dozen (15 to 30 cents per case) depending upon distance from the plant."

Jack and Kadar (9, p. 22) studied 10 farm routes for egg collection in 1967. They found that labor and truck costs averaged 21 cents a case with a range of 13 to 40 cents.

Raskopf and Nelms (15, p. 33) studied egg-assembly costs of 29 Tennessee firms in early 1968. They found that total truck and labor costs averaged 16 cents per case of eggs. The range in costs was from 12 cents a case in the low-cost group to 30 cents in the high-cost group. These low costs of assembly apparently reflect the effects of higher production density because the average number of cases handled per stop was 42. In Conlogue's Midwestern study, the average pickup was 2.5 cases.

Inplant costs for processors of egg products fall into two groups: breaking and freezing to obtain frozen-egg products, and drying to obtain dried-egg products.

Although some egg breaking is still done by hand as a salvage operation, the most important part of the volume is done by machine in specialized facilities. The commercial plants use machines and account for the bulk of the egg products produced.

In a 1967 study, Via (25, pp. 21-30) developed models for three specialized egg-breaking plants. They varied in size from 3.4 million to 10.1 million pounds of liquid eggs produced annually. The smallest plant had two automatic egg-breaking machines and the largest had six (table 13). In comparison with the production range for the model plants, egg-breaking plants under Federal inspection averaged 6 million pounds of liquid eggs in 1967. Inplant costs in the three model plants varied with volume of output and with revenue needed to yield specified rates of

Table 13.--Model egg-breaking plants: Size of plant and volume of input and output 1/

Model plant	Annual production of liquid eggs	Breaking machines	Volume of input 2/	Volume of output 2/
	Million pounds	Number	Shell eggs, cases	Liquid eggs, pounds
E.....	3.4	2	36	1,422
F.....	6.7	4	72	2,844
G.....	10.1	6	108	4,266

1/ "Specialized" egg breaking and freezing operations are plants operated as independent establishments, using automatic egg-breaking equipment.
2/ Per hour.

Source: Via, J.A., An Economic Analysis of Size and Locational Effects on Efficient Development of the Southeastern Egg Products Industry, N.C. State Univ., unpublished Ph.D. disser.,1967.

return on capital invested. Costs declined as volume of output increased, and they increased as rates of return to capital increased. For example, at the 18-percent rate of return to capital invested, costs declined from 5.05 cents a pound in plant E, which produced 3.4 million pounds a year, to 4.30 cents a pound in plant G, which produced 10.1 million pounds a year (table 14). Similarly, for plant F, which produced 6.7 million pounds a year, costs increased from 4.23 cents a pound at the 12-percent rate of return to 4.52 cents a pound at the 24-percent rate of return. Thus, there is no "one" cost of egg breaking. Rather, any cost estimate must be qualified with statements regarding size of the operation and rate of return to capital invested.

The second group of inplant costs is for the egg-drying operation. There are fewer egg-drying than egg-breaking plants. While some egg-drying plants are in separate facilities of their own, many are in facilities that are added to or are a part of an egg-breaking plant. Hence, the term "add-on" used by Via.

Via (25, p. 35) developed three model "add-on" egg-drying operations, varying in size from 0.5 million to 1.6 million pounds of annual output. Per hour, the smallest plant had an input of 864 pounds of liquid eggs and an output of 225 pounds of dried eggs. The largest plant had an input of 2,784 pounds of liquid eggs and an output of 725 pounds of dried eggs. Via's examples are limited to the spray-drying operation (table 15).

Economies of scale are very real in the egg-drying operation. At low, medium, and high rates of return to capital, small-volume plants have high per unit costs and large-volume plants have lower per unit costs. Via's study showed that drying costs ranged from 12.8 cents a pound in his smallest volume plant at the highest rate of return to capital, to 6.8 cents a pound in his largest volume plant at the lowest rate of return to capital. The middle estimate was 8.0 cents a pound for the middle-sized plant (1.2 millions pounds of production a year) at the 18-percent rate of return to capital (table 16).

Table 14.--Model egg-breaking plants: Costs of liquid-egg production in plants of various sizes and at various rates of return to capital

Model plant	Annual liquid-egg production	Total average costs plus revenue needed to yield rates of return to capital invested of --		
		12 percent	18 percent	24 percent
	Million pounds	Cents per pound		
E.....	3.4	4.88	5.05	5.22
F.....	6.7	4.23	4.38	4.52
G.....	10.1	4.15	4.30	4.44

Source: Via, J.A., An Economic Analysis of Size and Locational Effects on Efficient Development of the Southeastern Egg Products Industry, N.C. State Univ., unpubl. Ph. D. disser., 1967.

Table 15.--Model "add-on" egg-drying plants: Size of plant by volume of annual production, input of liquid eggs per hour, and output of dried eggs per hour 1/

Model plant	Dried eggs		
	Annual production	Volume of input per hour	Volume of output per hour
	Million pounds	Pounds	Pounds
J.....	0.5	864	225
K.....	1.2	2,016	525
L.....	1.6	2,784	725

1/ "Add-on" drying operations are conducted in egg-drying facilities built in connection with "specialized" breaking-freezing plants that use spray-drying equipment.

Source: Via, J.A., An Economic Analysis of Size and Locational Effects on Efficient Development of the Southeastern Egg Products Industry, N.C. State Univ., unpubl. Ph.D. disser., 1967.

Table 16.--Model "add-on" egg-drying plants: Costs of drying liquid eggs in plants of various sizes and at various rates of return to capital

Model plant	Annual dried-egg production	Total average costs plus revenue needed to yield rates of return to capital invested of --		
		12 percent	18 percent	24 percent
	Million pounds	Cents per pound of egg solids		
J.....	0.5	11.0	11.9	12.8
K.....	1.2	7.4	8.0	8.7
L.....	1.6	6.8	7.5	8.1

Source: Via, J.A., An Economic Analysis of Size and Locational Effects on Efficient Development of the Southeastern Egg Products Industry, N.C. State Univ., unpubl. Ph.D. disser., 1967.

Yields and Conversion Factors

The yield of liquid yolk and albumen from a case of eggs is the quantity of these items obtained from shell eggs excluding the shell and shell membrane.

Yields vary by season and by size, quality, and kind of egg. In commercial operations, yields are watched closely because a sudden change up or down can be a danger signal. In commercial plants, yields have increased through the years, which may reflect higher egg quality and larger egg size.

Yields can be expressed also as mathematical ratios; that is, one case of 30 dozen eggs yields an average of 39.5 pounds of liquid-egg meat. Or to put it another way, the 39.5 pounds of liquid eggs represents a conversion factor. Thus, to determine the amount of liquid eggs that can be obtained from any number of cases of eggs, one multiplies the number of cases by the conversion factor of 39.5. Conversion factors are needed when quantities of one kind of eggs are to be compared with quantities of another kind, and when costs are computed (table 17).

Spoilage Losses

No information is available on spoilage losses at the processing plants. The plants have used heat pasteurization to control salmonellae and other types of spoilage organisms.

Heat Pasteurization

Heat pasteurization, or its equivalent, has been required at egg processing plants since mid-1966. Before then, use of heat to pasteurize egg whites was experimental because of a technological problem. Since mid-1966, USDA has required pasteurization of egg products processed and packed under its inspection program, and the Food and Drug Administration (FDA) has required pasteurization of egg products moving in interstate commerce.

Via (25, p. 39) estimated costs of heat pasteurization of liquid eggs. He found that thermal pasteurization cost from 0.23 cent a pound in his largest volume plant at the lowest rate of return to capital invested, to 0.44 cent in his smallest volume plant at the highest rate of return. The middle estimate was 0.27 cent for the middle-sized plant (6.7 million pounds produced annually) at the 18-percent rate of return to capital (table 18).

A study (21, p. 67) for the U.S. Atomic Energy Commission (AEC) estimated the cost of thermal pasteurization at 0.12 cent a pound with the pasteurizer capacity at 2,500 pounds an hour. This estimate is less than half that for cost of pasteurization in Via's plant F. Even though the estimates differ in the two studies, the cost level for thermal pasteurization is relatively small.

Ionizing Irradiation as an Alternative to Heat Pasteurization

A possible method of controlling salmonellae and other micro-organisms in processed eggs is using ionizing irradiation and gamma rays (20, pp. 427-437). In this operation, liquid eggs would travel through pipes that would carry the eggs into a heavily shielded area where they would be subjected to a cobalt-60

Table 17.--Egg products: Estimated conversion factors for yields of liquid and dried eggs, and the moisture content of dried eggs, 1961

Egg products	Liquid yield from 30 dozen shell eggs	Yield from 1 dozen shell eggs		Requirements for 1 pound of dried-egg product		Yield of dried-egg product from --		Approximate moisture content of dried-egg product 1/
		Liquid eggs	Dried eggs	Liquid eggs	Shell eggs	100 lbs. liquid eggs	30 dozen shell eggs	
	Pounds				Dozen	Pounds		Percent
Whole eggs	39.50	1.317	0.343	3.84	2.92	26.04	10.29	2-3
Albumen (flake)	22.55	.752	.099	7.58	10.10	13.19	2.97	12-14
Albumen (spray)	22.55	.752	.096	7.84	10.42	12.76	2.88	5-8
Yolk	16.95	.565	.257	2.20	3.89	45.45	7.70	3.5-5

1/ Conversion factors were based on an average of the moisture content shown. It may have ranged as high as 5 percent in some packs of dried whole eggs.

Source: The conversion factors were taken from The Egg Products Industry of the United States, Kans. Agr. Expt. Sta. bul. 466, N. Cent. Regional Res. Publ. No. 154, Jan. 1964, table 16, p. 36.

Table 18.--Model egg-breaking plants: Cost of heat pasteurizing of liquid eggs in plants of various sizes and at various rates of return to capital 1/

Model plant	Annual production of liquid eggs	Average costs of pasteurizing liquid eggs by heat at various rates of return to capital invested of --		
		12 percent	18 percent	24 percent
	Million pounds	Cent per pound		
E.....	3.4	0.38	0.41	0.44
F.....	6.7	0.24	0.27	0.29
G.....	10.1	0.23	0.25	0.27

1/ When enough liquid eggs have accumulated for the continuous pasteurization process to begin, the eggs flow from the holding tank to a constant-level or float tank. A timing pump forces the eggs through the regenerator, and through the heating, holding, and cooling sections of a plate pasteurizing unit. The result is a properly pasteurized product.

Source: Via, J.A., An Economic Analysis of Size and Locational Effects on Efficient Development of the Southeastern Egg Products Industry, N.C. State Univ., unpublished Ph.D. disser., 1967.

radiation source. Alternatively, 30-pound cans of frozen eggs or packages of dried eggs could be moved into and out of the shielded area with a conveyor system. The recommended dose is 600,000 rads for processed-egg irradiation. 3/

Prior FDA approval of the process would be necessary before the irradiated products could be shipped in interstate commerce. Similarly, prior USDA approval would be necessary before the irradiated products could be packed in plants under the Department's inspection program.

The study (21, pp. 40 and 44) for the AEC developed capital and operating costs for irradiating processed eggs and other commodities. Estimated capital requirements for gamma radiation facilities were $536,000 for a plant capacity of 2,000 pounds an hour; $1,059,000 for a plant capacity of 5,000 pounds an hour; and $2,721,000 for a plant capacity of 15,000 pounds an hour. Operating costs included depreciation of the total initial investment and of the radiation source. Estimated operating costs were 1.17 cents a pound for a plant capacity of 2,000 pounds an hour; 0.89 cent for a plant capacity of 5,000 pounds; and 0.75 cent for a plant capacity of 15,000 pounds. Thus, the estimated cost per pound for ionizing irradiation is substantially higher than that for thermal pasteurization.

3/ A rad is the quantity of ionizing radiation that results in the absorption of 100 ergs per gram of irradiated material.

Wissman and Allwood (27, p. 29) reported on a cost-benefit analysis of irradiated pasteurization of processed eggs. For each of six plant sizes, a cash flow was developed, and the associated internal rate of return to capital invested was computed for source costs of 30, 40, and 50 cents a curie and source efficiencies of 20, 25, and 30 percent. 4/ The internal rates of return were negative for all six plants for each of the source-cost and source-efficiency combinations. These results were expected because of the low perishability of the products and the relatively small benefits that would accrue to the industry as a result of salmonellae control.

Wissman and Allwood (27, pp. 31-35) also made a public-sector analysis. They reasoned that public benefits accruing from salmonellae control would be realized in two forms: reductions in loss of work and reductions in medical expenses. The authors' assumptions were based on the small amount of information available on costs due to work loss and medical bills and on the number of cases of illness caused by salmonellae. They concluded in a projection: "Based on the above stated costs and revenues, an internal rate of return analysis was completed. The resulting rate of return was negative, even under the most favorable source cost and efficiency conditions. As in the cases in the industry analysis operating expenses exceeded revenues in each year during the 1975-85 period."

MARKETING

For processed-egg products, marketing generally begins when the egg products leave the processing plant to be transported, stored and distributed in the size of lot needed. Marketing ends when major end users buy and take delivery of the egg products for direct use or for use in products to be processed further.

Unless they are a part of a vertically integrated firm, processors of egg products may incur some costs of distribution and selling. When the products are processed and packed to meet contract specifications, selling costs may be minimized. However, processed, packed eggs that are sold through wholesalers may incur freight, warehousing, and brokerage fees or wholesalers' markups.

Transportation

Trucks are the main mode of transportation for egg products. In the major movement, frozen-egg products go from production areas in the Midwest and South to metropolitan consuming areas in the Northeast. Trains carry some dried-egg products, but trucks probably move the largest proportion. Tankers transport a relatively small share of liquid eggs from egg breakers to egg driers and large-volume food manufacturers. The following tabulation is a sample of trucking costs for frozen-egg products from various shipping points to New York City in May 1969:

	Cents per lb.
Topeka, Kans.	2.0
Rockford, Ill.	1.2
Raleigh, N.C.	1.0

4/ A curie is the unit of radioactivity, equivalent to 3.70×10^{10} disintegrations per second.

Atlanta, Ga. 1.15-1.25

Jackson, Miss. 1.55-1.60

Egg products often travel long distances. Estimates of per capita production by region illustrate such movements (table 19). Despite the sharp gains registered in the South Atlantic, South Central, and Western regions from 1958-62 to 1968-69, the West North Central region remains the major supplier for other regions.

Broker's Charges

The traditional function of the broker -- bringing together buyer and seller -- is involved in a relatively small proportion of the packed egg products. This is because most of these products are packed under contract or to meet specifications of a particular food manufacturer. When applicable, brokerage charges at New York City for truckload lots of 30,000-36,000 pounds are 0.15 to 0.25 cent a pound, mostly 0.25, for frozen whole eggs; 0.20 to 0.30 cent a pound, mostly 0.25, for whites; and 0.50 to 1.00 cent a pound, mostly 0.50-0.75, for yolks. For lots of 5,000-10,000 pounds, brokerage charges are 0.50 to 1.00 cent a pound, mostly 0.50, for all classes of egg products. The charge of 1.0 cent a pound includes financing by the broker.

For dried eggs, brokerage charges at New York City are 2.0 to 4.0 cents a pound, no extra handling and off-truck. Financing by the broker may or may not be included. When these eggs are handled through a warehouse or place of business, the charge is 3.0 to 6.0 cents a pound, mostly 4.0 cents, and usually includes the financing. In the Midwestern States, brokerage charges are 0.75 to 1.0 cent a pound for dried eggs in truckload lots.

Interest Costs

Interest is usually considered a cost because money is invested in the product until it is sold. For example, if frozen whole eggs are worth 30 cents a pound at New York City and the cost of money is 8 percent, then the cost of interest would be 0.2 cent a pound a month. Although this is a very small monthly cost, it becomes important when multiplied by the number of pounds in a truckload lot. To continue the example, assume a truckload lot contains 1,000 cans of 30 pounds each, or a total of 30,000 pounds. When 30,000 is multiplied by 0.2 cent for interest, the result is a cost of $60 a month.

Cold-Storage Costs

The seller or buyer incurs warehousing fees because frozen-egg products must be kept frozen, and many dried-egg products are kept in cooler or freezer space. Warehouse charges vary from city to city, but usually are competitive within cities. The charges also vary according to kind of product, temperature of the space, size of lot, and other services rendered. For instance, rates charged in New York City are about 10 cents per hundredweight higher than those in Kansas City. This is to be expected because all costs are generally higher in New York City.

Table 19.--Liquid-eggs: Estimated per capita production, by region, 1958-62, 1963-67, and 1968-69

Region	Production			Population			Per capita production		
	1958-62	1963-67	1968-69	1958-62	1963-67	1968-69	1958-62	1963-67	1968-69
	Million pounds			Millions			Pounds		
North Atlantic....	12	16	23	45	47	48	0.3	0.3	0.5
East North Central..	97	96	95	36	38	40	2.7	2.5	2.4
West North Central..	437	370	330	15	16	16	29.1	23.1	20.6
South Atlantic.....	18	66	79	26	28	30	.7	2.4	2.6
South Central.....	18	66	66	29	31	32	.6	2.1	2.1
West.....	24	46	66	27	31	33	.9	1.5	2.0
United States....	606	660	659	179	190	199	3.4	3.5	3.3

Source: Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 20.--Egg products: Comparison of warehouse rates at Kansas City and New York City, May 1969

Egg product	Kansas City	New York City
	Cents per cwt.	
Frozen eggs:		
15,000 pounds and up		
Handling into and out of warehouse	28	36
Storage rate a month	20	31
Freezing charge	25	33
1,000-pound lots at Kansas City		
Lots under 2,000 pounds at New York City		
Handling into and out of warehouse	43	53
Storage rate a month	30	47
Freezing charge	25	33
Dried eggs:		
20,000 pounds and up		
Handling into and out of warehouse	29	42
Storage rate a month in --		
Dry storage	1/	26
Cooler storage	22	36
Freezer storage	1/	48
Under 20,000 pounds		
Handling into and out of warehouse	43	43
Storage rate a month in --		
Dry storage	1/	36
Cooler storage	26	46
Freezer storage	1/	56

1/ Not available.

Source: Sample tariffs from warehouse firms.

Table 21.--Eggs and egg products: Cold-storage holdings, June 30, 1951-June 30, 1969, and monthly averages, 1965-69

Year	June 30 holdings						
	Actual counts			Converted to shell-egg equivalent			
	Shell eggs	Frozen eggs	Dried eggs	Shell eggs	Frozen eggs 1/	Dried eggs 2/	Total
	1,000 cases	1,000 pounds		1,000 cases			
1951	2,427	189,980	46,211	2,427	4,935	4,530	11,892
1952	3,357	166,419	10,624	3,357	4,323	1,042	8,722
1953	1,513	159,755	3,724	1,513	4,150	365	6,028
1954	1,639	186,189	3,939	1,639	4,836	386	6,861
1955	2,292	193,888	4,748	2,292	5,036	465	7,793
1956	1,453	172,366	5,442	1,453	4,477	534	6,464
1957	1,812	166,942	7,019	1,812	4,336	688	6,836
1958	852	134,218	2,140	852	3,398	210	4,460
1959	1,054	149,175	3/	1,054	3,777	3/	4,831
1960	1,110	157,040	3/	1,110	3,976	3/	5,086
1961	365	112,565	3/	365	2,850	3/	3,215
1962	397	110,843	3/	397	2,806	3/	3,203
1963	274	102,870	3/	274	2,604	3/	2,878
1964	201	105,648	3/	201	2,675	3/	2,876
1965	525	84,334	3/	525	2,135	3/	2,660
1966	101	55,486	3/	101	1,405	3/	1,506
1967	427	84,663	3/	427	2,143	3/	2,570
1968	287	107,703	3/	287	2,727	3/	3,014
1969	300	60,660	3/	300	1,536	3/	1,836

Month	Distribution of monthly average, 1965-69			Percentage of total by months, 1965-69 average			
	Shell eggs	Frozen eggs	Dried eggs 3/	Shell eggs	Frozen eggs	Dried eggs 3/	Total
	Percent			Percent			
January	3.5	7.5		3.9	96.1		100.0
February	3.6	6.8		4.5	95.5		100.0
March	2.9	6.3		3.9	96.1		100.0
April	2.6	6.3		3.6	96.4		100.0
May	5.4	6.9		6.4	93.6		100.0
June	12.0	8.1		11.6	88.4		100.0
July	18.1	9.7		14.1	85.9		100.0
August	16.2	10.5		11.9	88.1		100.0
September	12.6	10.6		9.5	90.5		100.0
October	10.0	10.0		8.1	91.9		100.0
November	8.1	9.2		7.3	92.7		100.0
December	5.0	8.1		5.1	94.9		100.0
Total	100.0	100.0		8.1	9.9		100.0

1/ Frozen eggs were converted to shell-egg equivalent on a basis of 38.5 pounds a case, 1951-57; and 39.5 pounds, 1958-59.

2/ Dried eggs were converted to shell-egg equivalent at 10.2 pounds of dried eggs a case.

3/ Statistics not published.

Source: Compiled from reports of Stat. Rpt. Serv., U.S. Dept. Agr.

As an illustration, a truckload lot of 30,000 pounds of frozen eggs at Kansas City would be charged the following: 28 cents a hundredweight for handling into and out of the warehouse plus 20 cents a hundredweight for the first month's storage or a total of 48 cents a hundredweight. The freezing charge would apply only if the product needs to be frozen. The subsequent storage charge would be 20 cents a hundredweight a month. When the product is taken out of storage, there would be no fee for handling because that fee was paid the first month (table 20).

Cold-Storage Holdings

Cold-storage holdings of shell, frozen, and dried eggs declined from nearly 12 million shell-egg case equivalents in 1951 to 1.8 million in 1969. During these years, the need for storing eggs declined because the seasonality of egg production was leveling off.

Composition of the holdings in 1951, in shell-egg case equivalents, was 4.9 million cases of frozen eggs, 4.5 million cases of dried eggs, and 2.4 million cases of shell eggs (table 21). Since then, storage holdings of all three forms of the product have declined irregularly. By 1959, storage holdings of dried eggs were no longer reported although some dried eggs were undoubtedly stored after that date. By 1969, frozen-egg holdings were about a third of what they had been in 1951, and shell-egg holdings were about one-tenth. Thus, by 1969, total storage holdings were 1.8 million shell-egg case equivalents, with frozen eggs making up nine-tenths of the total and shell eggs the remainder. For 1965-69, frozen-egg holdings accounted for an average 92 percent of the shell-egg equivalent holdings and shell eggs accounted for the remaining 8 percent.

During 1965-69, seasonal variation within each year for shell eggs showed that the lowest month for storage holdings was April while the peak month was July. For frozen eggs, the low months were March and April while the peak months were August and September. The low and high months for shell eggs showed wider seasonal variation than did the low and high months for frozen eggs (table 21, lower part).

For each month of the year during 1965-69, frozen eggs made up the largest part of storage holdings. The lowest month was July, when frozen eggs accounted for 85.9 percent of the shell-egg equivalent total; and the highest month was April, when frozen eggs accounted for 96.4 percent of the shell-egg equivalent total (table 21, lower part).

Time Lapse in Marketing

Among processed egg products, rather wide differences can be observed in the time lapse in marketing. Liquid-egg products must be marketed quickly to avoid spoilage. Liquid eggs provide an excellent media for the growth of bacteria and can be kept only a few days under the best conditions. Frozen eggs can be kept a year or more, but a yearly turnover in inventory is considered desirable. Although some eggs are broken out and frozen year round, most frozen eggs are spring packs. Thus, previous spring packs need to be moved to make room for the current ones. For certain kinds of end uses, frozen eggs need to be kept in storage for several months so they can go through an aging process. Dried eggs can be kept a year or more, especially if (1) they are a high-quality product in which the moisture has been reduced to a minimum and (2) they have been packed in airtight containers in which the oxygen has been replaced by nitrogen.

Prices

Wholesale selling prices for frozen- and dried-egg products are determined in large metropolitan areas. Lists are published currently at New York City, Chicago, and San Francisco. Lists of prices for deliveries to bakers, hotels, and restaurants are published at Pittsburgh. The level of the wholesale prices of egg products (table 22) tends to rise and fall with the level of prices paid producers (table 23). For 1963 through 1969, the relationship between prices paid Iowa producers, at farm, for grade A or better, large, mixed-color eggs from "other production" and the wholesale selling price at New York City for frozen whole eggs in 30-pound tin cans in truckload lots showed a correlation coefficient of 0.91. The relationship was significant at the 0.02 level. In years when the price of stock for breaking is high, the price of egg products is high and in years when the price of this stock is low, the price of the products is low. Two recent studies give a sophisticated analysis of pricing relationships between the table egg market and the egg-breaking market. (These relationships are reviewed more completely in the section on demand in this report.) The level of prices to Iowa producers and the wholesale price of frozen eggs at New York City are within a cent or two of each other most of the time. This relationship is deceptive because the price to producers is per dozen eggs while the price for frozen eggs is per pound. One dozen shell eggs yields 1.317 pounds of liquid eggs, on the average (table 17).

Prices of yolks and whites are interrelated and need to be considered jointly (table 22). Usually, yolks are in greater demand than whites; thus, the price of yolks needs to be high enough to compensate the processor for the lower price he must accept on the whites. In other words, the price of whites times their yield plus the price of yolks times their yield plus the cost of separation must add up to at least as much as the price of whole eggs (13, p. 57).

Less seasonal variation occurs in the prices of egg products than in the prices of shell eggs. This can be observed by comparing tables 24 and 25 with table 23. Voss (26, p. 32) explains: "Prices of egg products in the spring months are related to the cost of shell eggs and to the anticipated demand for the output of processing plants some months later. Contracts with large users made in the late winter or early spring for delivery throughout the season have a stabilizing influence on prices."

Storers of egg products hope that the prices of egg products in the fall months will cover costs of processing and freezing the eggs in the spring months plus the cost of storage when the products are taken out of storage in the fall or winter months. For the years shown in tables 24 and 25, this appeared to happen in 4 out of 7 years.

Price Spreads

The differences or spreads among prices in various geographical areas or between trading levels indicate the customary costs and margins over time. Based on prices paid producers for breaking stock in Iowa and on wholesale selling prices for frozen whole eggs in various cities, the spreads between the Iowa prices and city prices are seen to increase as distance of the cities from the Midwest increases. Thus, spreads at New York and Philadelphia are wider than those at Chicago and spreads at San Francisco are still wider (table 26). The differences between markets are due mainly to the differences in transportation costs. Level

Table 22.--Frozen and dried eggs: Wholesale selling prices at New York City, 1954-69

Year	Frozen eggs (cents per pound, 30-pound tin cans in car- or truck-lots					Dried eggs (dollars per pound, in lots of 1-50 drums or barrels)				
	Whole	Blends	Whites	Yolks		Whole 1/	Yolks	Albumen		
				Sugared	Salted			Flake	Powdered	Spray
	Cents					Dollars				
1954	28.4	34.3	17.9	43.6	43.4	1.21	1.15	1.55	1.59	1.63
1955	31.7	34.0	21.1	42.0	41.3	1.17	1.10	1.71	1.75	1.80
1956	30.9	34.5	23.0	41.1	40.3	1.18	1.07	1.97	2.00	2.07
1957	27.5	32.4	14.2	44.1	43.0	1.08	1.10	1.31	1.35	1.35
1958	30.2	35.3	13.1	53.3	50.5	1.19	1.29	1.16	1.20	1.20
1959	26.0	33.0	12.8	46.3	45.6	1.05	1.18	.97	1.00	.98
1960	27.9	34.8	8.8	49.6	48.8	1.12	1.32	.86	.89	.87
1961	30.4	36.2	9.8	53.8	51.7	1.17	1.38	.89	.92	.90
1962	27.7	32.0	12.1	2/44.7	42.7	1.06	1.16	1.07	1.11	1.09
1963	26.8	32.6	15.4	2/43.8	42.1	1.09	1.13	1.31	1.34	1.31
1964	26.0	32.8	15.5	2/42.0	40.2	1.06	1.04	1.34	1.37	1.35
1965	25.7	32.3	14.0	2/43.2	41.7	1.05	1.05	1.16	1.19	1.13
1966	31.8	3/	15.0	54.8	54.6	1.31	1.42	1.38	1.36	1.33
1967	24.7	3/	11.5	43.0	3/	1.04	1.15	1.14	1.16	1.04
1968	23.9	3/	13.5	40.3	3/	.99	1.05	3/	3/	1.06
1969	30.5	3/	19.6	48.7	3/	1.26	1.29	3/	3/	1.55

1/ Palatability 7.
2/ Average of light and dark color, 1963-65.
3/ Not computed because of insufficient price data.

Source: Annual issues of Dairy and Poultry Market Statistics, Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 23.--"Other farm eggs": Iowa prices paid per dozen grade A large to producers at farm, cases exchanged, United States, 1963-69

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	Cents per dozen												
1963	30.30	31.39	29.40	24.75	22.52	23.78	26.43	27.89	33.33	31.52	30.50	28.83	28.39
1964	30.82	26.55	26.84	23.52	23.03	23.66	25.98	30.81	29.57	28.91	26.79	24.91	26.78
1965	20.42	21.24	22.33	23.95	21.20	22.36	23.69	27.02	31.00	32.05	33.50	34.83	26.13
1966	30.55	34.37	36.00	32.07	25.21	25.95	31.60	34.20	39.24	35.07	36.62	33.76	32.87
1967	27.76	23.87	26.02	20.00	19.70	19.34	23.25	21.37	23.90	20.11	21.20	23.55	22.50
1968	21.80	20.00	21.71	20.77	18.84	21.92	25.00	26.89	35.38	30.17	31.92	34.98	25.78
1969	35.13	29.92	30.88	29.30	23.45	23.55	31.14	30.55	34.62	34.04	43.80	48.31	32.90
Average	28.13	26.7	27.60	24.91	21.99	22.94	26.73	28.39	32.43	30.27	32.05	32.74	27.91

Source: Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 24.--Frozen whole eggs (light-colored): Monthly average wholesale selling prices, New York City and Philadelphia, 1963-69

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	Cents per pound												
1963	25.6	29.4	28.7	26.4	25.6	25.2	25.7	26.2	27.3	27.4	26.9	27.2	26.8
1964	28.6	27.4	26.5	25.2	24.9	24.7	25.4	25.7	26.2	26.2	25.6	24.2	26.0
1965	22.8	22.8	22.7	23.3	24.2	25.8	26.5	26.4	26.3	27.9	29.1	30.1	25.7
1966	28.6	31.3	34.8	33.2	29.3	29.1	29.6	31.7	32.8	32.3	34.1	34.9	31.8
1967	30.2	27.0	25.9	24.3	24.5	24.6	24.3	24.3	23.8	22.3	22.5	22.4	24.7
1968	21.9	21.4	22.2	22.3	22.2	23.5	23.8	23.5	24.7	26.7	27.3	27.1	23.9
1969	27.3	27.4	27.5	27.3	26.4	26.0	27.0	28.5	31.2	35.2	40.7	41.7	30.5
Average	26.4	26.7	26.9	26.0	25.3	25.6	26.0	26.6	27.5	28.3	29.5	29.7	27.1

Source: Annual issues of Dairy and Poultry Market Statistics, Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 25.--Dried whole eggs: Monthly average wholesale selling prices, New York City, 1963-69 1/

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	Dollars per pound												
1963....	1.08	1.15	1.14	1.06	1.06	1.04	1.04	1.10	1.11	1.12	1.09	1.10	1.09
1964....	1.11	1.11	1.08	1.03	1.01	1.01	1.01	1.01	1.03	1.03	1.03	1.01	1.04
1965....	.98	.98	.98	.98	.99	.99	1.02	1.04	1.06	1.10	1.20	1.23	1.05
1966....	1.23	1.26	1.32	1.28	1.20	1.17	1.20	1.33	1.37	1.43	1.45	1.44	1.31
1967....	1.30	1.16	1.10	1.03	1.00	1.01	1.01	1.01	1.01	.99	.96	.96	1.04
1968....	.93	.92	.90	.89	.91	.97	.98	1.00	1.05	1.11	1.12	1.12	.99
1969....	1.14	1.11	1.14	1.14	1.12	1.12	1.18	1.27	1.35	1.41	1.51	1.63	1.26
Average:	1.11	1.10	1.09	1.06	1.04	1.04	1.06	1.11	1.14	1.17	1.19	1.21	1.11

1/ Average of weekly prices in lots of 1-50 drums or barrels.

Source: Annual issues of Dairy and Poultry Market Statistics, Consum. and Mktg. Serv., U.S. Dept. Agr.

Table 26.--Price spreads between prices paid Iowa egg producers for "other farm eggs" (converted to liquid eggs) and wholesale selling prices for frozen whole eggs in selected cities, 1963-69

Year	Price spreads between prices paid Iowa egg producers for "other farm eggs" (converted to liquid eggs) 1/ and --			
	Wholesale selling prices for frozen whole eggs at -- 2/			Prices for deliveries to bakers, hotels, and restaurants at Pittsburgh 3/
	Chicago	New York and Philadelphia	San Francisco	
	Cents per pound			
1963	4.7	5.3	8.5	8.7
1964	4.5	5.7	9.8	9.5
1965	5.1	5.9	9.0	9.2
1966	6.1	6.8	10.8	11.5
1967	7.3	7.6	14.3	15.2
1968	4.6	4.3	8.5	11.5
1969	5.6	5.5	7.9	13.0
Average	5.4	5.9	9.8	11.2

1/ Prices paid per dozen were multiplied by 30 to put them on a per case basis. These numbers were then divided by 39.5, the yield (pounds) of liquid eggs per case of shell eggs. "Other farm eggs" are those not under incentive and quality-control programs.

2/ In 30-pound tin cans in carlots or trucklots.

3/ In 30-pound tin cans in lots of 1-5 cans.

and volume of sale also influence price spreads. Thus, spreads determined by using prices of frozen eggs sold to bakers, hotels, and restaurants at Pittsburgh are wider than those based on wholesale selling prices at New York and Philadelphia (table 26).

Spoilage Losses During Marketing

No information is available on the extent or amount of spoilage losses among egg products during marketing. However, some is known to exist because of seizures and recalls by the FDA. For fiscal years 1965 through 1968 and up to November 30, 1968, the FDA recorded 51 cases of seizures and 21 cases of recalls due to salmonellae contamination among eggs and egg products (7).

DEMAND

Per Capita Consumption

Total egg consumption on a per capita basis reached a high point during World War II. Since the early 1950's, such consumption has declined (table 27). However, there is a difference between the trends for shell eggs and processed eggs. For processed eggs, per capita consumption has been increasing since the early 1950's. For shell eggs, the trend has been the opposite.

Exports and Imports

Exports of egg products by U.S. processors were large during World War II, but since then have dwindled to relatively small amounts. In recent years, they have amounted to less than one-tenth of 1 percent of total farm production (table 28).

Imports of egg products have also been very small recently. Only twice since 1950 have imports amounted to one-tenth of 1 percent or more of domestic production.

Major End Users

A study (6, p. 4) was made of U.S. food manufacturing industries to determine the major end uses of egg products. Industries surveyed were bakeries, confectioners, premix manufacturers, and a miscellaneous group including firms making baby food, meat and fish products, noodles, macaroni, ravioli, mayonnaise, salad dressings, and a variety of specialty products.

Bakeries, the largest users of egg products, purchased about 79 percent of their egg requirements in frozen form and 13 percent in dried form (table 29). With the exception of one very large firm that used a considerable amount of liquid egg whites, confectionery firms used frozen and dried egg albumen and substantial quantities of egg substitutes, such as soy albumen, lecithin, and gelatin. Premix manufacturers used dried eggs almost exclusively. Food manufacturers in the miscellaneous group used mostly frozen eggs and a relatively large quantity of shell eggs.

Table 27.--Shell and processed eggs: per capita consumption, United States, 1951-69

Year	Per capita consumption of --			Processed egg consumption as proportion of total
	Shell eggs	Processed eggs	All eggs	
	Number			Percent
1951	365	27	393	6.9
1952	362	28	390	7.2
1953	354	25	379	6.6
1954	351	25	376	6.6
1955	346	25	371	6.7
1956	345	24	369	6.5
1957	335	27	362	7.5
1958	328	26	354	7.3
1959	319	33	352	9.4
1960	306	28	334	8.4
1961	298	30	328	9.1
1962	296	30	326	9.2
1963	290	27	317	8.5
1964	287	31	318	9.7
1965	285	29	314	9.2
1966	283	30	313	9.6
1967	289	34	323	10.5
1968	288	32	320	10.0
1969	285	31	316	9.8

Source: Handbook of Agricultural Charts, 1967, Agr. Hdbk. 348, U.S. Dept. Agr., and data published currently in Poultry and Egg Situation Reports, Econ. Res. Serv., U.S. Dept. Agr.

Table 28.--Egg products: Comparison of exports and imports with farm production, 1947-69

Year	Egg products				Tariffs on imports for --	
	Exports	Imports	Exports as % of farm production	Imports as % of farm production	Egg solids	Frozen eggs
	Million pounds		Percent		Cents per pound	
1947	63	1/	1.1	2/	27	11
1948	41	1/	0.7	2/	17	7
1949	28	2	0.5	2/	17	7
1950	49	8	0.8	0.1	17	7
1951	49	1/	0.8	2/	27	11
1952	7	1/	0.1	2/	27	11
1953	3	1	2/	2/	27	11
1954	2	1/	2/	2/	27	11
1955	1	1/	2/	2/	27	11
1956	3	1/	2/	2/	27	11
1957	2	1/	2/	2/	27	11
1958	1	1/	2/	2/	27	11
1959	7	1/	0.1	2/	27	11
1960	8	1/	0.1	2/	27	11
1961	9	1/	0.1	2/	27	11
1962	6	1/	0.1	2/	27	11
1963	6	1/	0.1	2/	27	11
1964	4	1/	0.1	2/	27	11
1965	3	1/	2/	0.2	27	11
1966	2	13	2/	2/	27	11
1967	1	1	2/	2/	27	11
1968	1	1	2/	2/	27	11
1969	1	3	2/	2/	27	11

1/ Less than 0.5 million pounds.
2/ Less than one-tenth of 1 percent.

Source: For. Agr. Serv., U.S. Dept. Agr.

Table 29.--Eggs and egg substitutes: Use in various forms, by food industries surveyed, United States, 1960

Industry	Firms	Average quantity used per firm	Percentage of eggs used in various forms 1/					
			Shell	Liquid	Frozen	Dried	Sub-stitute	All forms
	No.	1,000 lbs.	Pct.					
Baking	210	521.3	2	5	79	13	1	100
Confectionery 2/	34	176.4	0	63	26	4	7	100
Premix	28	282.4	0	0	3/	99	1	100
Other 4/	61	443.8	34	3	60	3	3/	100

1/ Based on actual weights, not liquid equivalents.
2/ Mostly albumen.
3/ Less than 0.5 percent.
4/ Includes firms making baby foods, meat and fish products, noodles, macaroni, ravioli, mayonnaise, salad dressing, and a variety of speciality foods.

Source: Present and Potential Use of Egg Products in the Food Manufacturing Industry, Econ. Res. Serv., U.S. Dept. Agr., Mktg. Research Rpt. 608, June 1963, p. 4.

Because of the type of sample used in the above study, generalizations to a total are not valid. For example, no indication was given of the importance of the quantities of egg products used by all confectioners versus the quantities used by all premix manufacturers. Only the sample was reported on.

USDA Purchases

In the 1950's and 1960's, USDA purchases of eggs were mainly in the dried-egg form. However, in 1968 and 1969, the Department purchased egg mix containing 51-percent dried eggs. The figures in tables 30 and 31 for USDA purchases are for the dried-egg portion of the mix.

USDA purchases for 1951-69 were not stable. Quantities bought varied from zero in some years to 22.5 million pounds in 1961. The significance of these purchases varies with the year in question and the method of comparison. When compared with total egg production, USDA purchases were relatively small in most years; when compared with the production of dried eggs only, the purchases were relatively large in some years. The peak year of USDA purchases in the postwar period was 1961; these amounted to 1.3 percent of eggs sold from farms and 13.6 percent of eggs used for breaking (table 30). During the postwar years, about one-third or a little more of the eggs used for breaking were dried (table 4). When USDA purchases of dried eggs were compared with total dried egg production, considerable variation was evident in the importance of these purchases (table 31). They varied from 41 percent in 1960 and 1961 to zero in 1965 and 1966. In most years when USDA purchased dried eggs, these purchases accounted for significant proportions of the dried eggs produced.

Elasticity of Demand

The demand for eggs with respect to price is generally considered to be inelastic. Gerra (8, p. 2) concludes: "A 1 percent change in the retail price of eggs, on the average, would be associated inversely with about a -0.4 percent change in the per capita consumption of eggs, after allowing for the effect of other economic factors." He also states that this estimate compares closely with estimates of other researchers.

The demand for processed-egg products is probably more inelastic with respect to price than is the demand for eggs in general. Koudele and Heinsohn (13) believe: "The level of prices seems to have only a minor effect on the consumption of frozen and dried whole eggs in regular commercial channels. Demand for these products, just as for shell eggs, is relatively inelastic. Baker's requirements for various types of yellow cakes tends to be quite stable from month to month."

Voss (26, p. 39) agrees in part: "Egg products appear to have an inelastic demand. Institutions, manufacturers of items like noodles and salad dressing and bakers use a high percentage of the egg products. There is little opportunity for varying recipes to adjust for the cost of the eggs used."

Enochian and Saunders (6, pp. ii and iii) concur that: "Eggs are only one of a number of ingredients used by food manufacturers in a given end product and frequently account for a relatively small percentage of the total recipe or mix. But the cost of every ingredient, no matter how small it may be in relation to total ingredient cost, is carefully evaluated. Very large food manufacturers frequently spend many thousands of dollars for egg products annually.

Table 30.--Eggs used for breaking: USDA purchases compared with eggs sold from farms, United States, 1951-69

Year	Eggs sold from farms	Eggs used for breaking	USDA purchases, shell-egg equivalent[1/]	Eggs used for breaking as a percentage of eggs sold from farms	USDA purchases as a percentage of eggs produced: Eggs sold from farms	USDA purchases as a percentage of eggs produced: Eggs used for breaking
	1,000 cases			Percent		
1951	144,047	10,614	0	7.4	0	0
1952	144,470	9,927	227	6.7	0.2	2.3
1953	145,025	10,682	0	7.4	0	0
1954	148,100	12,102	0	8.2	0	0
1955	150,042	11,778	0	7.8	0	0
1956	155,345	12,074	584	7.4	0.4	4.8
1957	156,036	12,331	783	7.4	0.5	6.3
1958	158,611	12,172	411	7.4	0.3	3.4
1959	164,108	17,755	1,884	9.7	1.1	10.6
1960	160,606	14,746	1,849	8.0	1.2	12.5
1961	165,303	16,074	2,185	8.4	1.3	13.6
1962	168,175	16,070	1,263	8.8	0.8	7.9
1963	168,806	14,860	815	8.3	0.5	5.5
1964	174,378	16,684	1,531	8.7	0.9	9.2
1965	176,767	15,919	0	9.0	0	0
1966	180,200	15,731	0	8.7	0	0
1967	190,203	20,297	236	10.7	0.1	1.2
1968	188,547	17,133	833	9.1	0.4	4.9
1969	188,203	16,212	739	8.6	0.4	4.6

1/ For school lunch and other programs. These purchases were of dried eggs, mainly. 1968 and 1969 purchases were of egg mix containing 51-percent dried eggs.

Source: Selected issues of the Poultry and Egg Situation, Econ. Res. Serv., U.S. Dept. Agr.; and data computed from these issues.

Table 31.--Egg solids: USDA purchases compared with total production of egg solids and quantities used in commercial trade channels, United States, 1951-69 1/

Year	Total production of egg solids	USDA purchases		Egg solids used in commercial trade channels 2/
		Amount	Share of total production	
	Million pounds		Percent	Million pounds
1951	17.6	4/	4/	17.6
1952	17.3	2.3	13.3	15.0
1953	19.5	4/	4/	19.5
1954	22.5	4/	4/	22.5
1955	23.1	4/	4/	23.1
1956	22.1	6.0	27.1	16.0
1957	28.6	4.8	16.8	23.8
1958	25.3	4.2	16.6	21.1
1959	54.7	3/19.4	35.5	35.3
1960	46.1	19.0	41.2	27.1
1961	54.5	22.5	41.3	32.0
1962	50.7	13.0	25.6	37.7
1963	44.7	8.4	18.8	36.3
1964	52.0	15.8	30.4	36.2
1965	50.1	4/	4/	50.1
1966	51.5	4/	4/	51.4
1967	70.7	2.4	3.4	68.3
1968	65.3	5/8.5	13.0	56.8
1969	61.1	5/7.6	12.5	53.5

1/ Dried weight.
2/ Difference between annual production and Government purchases.
3/ An additional 4,110,000 pounds of frozen mixed whole eggs were purchased for later drying.
4/ USDA made no purchases.
5/ USDA purchases were in the form of dried-egg mix. Figures in this table are for the egg solids portion only (51 percent of the mix).

Source: Econ. Res. Serv., U.S. Dept. Agr., Poultry and Egg Situation, Mar. 1951, Nov. 1959, Nov. 1962, and Sept. 1968.

"Most food manufacturers did not change the amount or type of egg product in formulas to adjust for season or short-term variations in egg prices. Nor did they change end product prices. Changes in formulations were instituted only after egg prices had experienced long-term permanent changes."

Rogers and Bluestone (17, p. 49) conclude: "(1) There has been a downward shift in demand, (for eggs), probably related to changing living patterns, that has more than offset any price-boosting effect associated with rising income; (2) the demand for eggs is highly inelastic; and (3) the demand for liquid egg is much more inelastic than the demand for shell eggs."

Bange and Bender (2, pp. 33 and 41) report: "The simultaneous equation models yielded estimates for this elasticity (shell eggs with respect to own price) which were nearly always (during all months of year) in the vicinity of -0.2.

"Fortunately, the demand for breaking eggs is approximately inversely related to the demand for table eggs. When the demand for table eggs is weakest, the demand for breaking eggs is strongest. Breakers, by operating in the traditional seasonal pattern when egg prices are low in response to excess supplies and slack demand, have the beneficial effect to producers of bidding up prices which would otherwise be even lower.

"The results of this analysis indicate that the demand for breaking eggs approaches the inelastic range in the spring months when the demand for breaking eggs is the strongest."

Alexander and Baker (1, pp. 32 and 29) report: "The results of Model II indicate that for the period 1962-67, the demand for shell eggs was substantially lower in the second quarter of the year than in the first but the demand for breaking eggs was considerably higher in the second quarter than in the first quarter of the year.

"The monthly elasticity of demand for shell eggs at the wholesale level of marketing computed at the mean from the two-stage least squares estimates of Model II was -.49, while the monthly elasticity of demand for breaking eggs was computed from Model II two-stage least squares estimates to be -1.27.

"It appears that breaking operations in the major breaking season provide an alternative market outlet for eggs which become available as a result of lower shell egg demand and, in consequence, act as a buffer for shell egg prices. The level of breaking egg prices, therefore, appears to be linked to that of shell egg prices while breaking egg utilization appears to be a residual claimant on egg supplies."

THE FUTURE

What does the future hold for eggs in general and processed-egg products in particular? While egg production has increased since World War II, per capita consumption declined from 393 eggs in 1951 to 314 in 1969. The decline occurred in shell-egg consumption; processed-egg consumption increased moderately.

Several factors explain the decline in per capita consumption of shell eggs. Heavy breakfasts are in less demand than before because many jobs are not as strenuous as they used to be. More homemakers are working, which reduces the amour of time that they have to prepare meals. More meals are being eaten away from hom-

People are more weight-conscious than in the past; and they are concerned about the effects of various kinds of food on their health. Highly advertized breakfast cereals offer increasing competition for eggs. These factors are apt to continue to affect shell-egg consumption. Thus, the outlook is for a downward trend in their per capita consumption.

Some of the same factors will increase per capita consumption of egg products. The office workers who do not eat breakfast, but have pastry and coffee at morning break, are eating some processed eggs. The homemaker who bakes a cake from a premix may be using such eggs. Restaurants, hotels, institutions, and so on, frequently use processed eggs because of the convenience. As the number of meals eaten away from home increases, so does processed-egg consumption. These factors alone would assure continued growth.

Jones (11, p. 16) made projections of production and prices for processed eggs to 1975 and 1980. He projected quantities of 1.0 billion pounds in 1975 and 1.3 billion in 1980. Production ranged from 0.6 to 0.8 billion pounds annually during 1965-69.

His projection of wholesale prices is 25 cents a pound for frozen whole eggs at New York City for both 1975 and 1980. This price is on the low side of the price range for 1965-69. During those years, the price ranged from 23.9 cents to 31.8 cents a pound at New York City.

From his production and price projections, Jones estimates the value of egg products produced to be $260 million in 1975 and $318 million in 1980.

However, an additional market potential exists in new consumer products that are being developed. If more and more of these products are accepted, per capita consumption of egg products is likely to offset the expected decrease in consumption of shell eggs, and thus will help stabilize the per capita consumption of all eggs.

Increasing amounts of egg products are expected to be produced in the South Atlantic, South Central, and Western regions. Growth in these regions will depend on increasing egg production and on the need for an outlet for surplus supplies and for other eggs not in demand for table use. The West North Central region is expected to decrease its output of egg products, but it will still be the largest producer of these products among the regions.

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